REMARKS

This is intended as a full and complete response to the Office Action dated June 15, 2004, having a shortened statutory period for response set to expire on September 15, 2004. Please reconsider the claims pending in the application for reasons discussed below. In view of the above amendment and the following discussion, Applicants submit that none of the claims now pending in the application are anticipated under the provisions of 35 U.S.C. § 102 or obvious under the provisions of 35 U.S.C. § 103. Thus, Applicants believe that all of the claims are now in condition for allowance.

I. Improper Claim

Claim 2 was objected to by the Examiner for depending from claim 6. Claim 2 is canceled without prejudice by this amendment, thereby obviating the objection.

II. Rejections Under 35 U.S.C. §102

A. Claims 3 and 11

Claims 3 and 11 stand rejected as being anticipated under 35 USC § 102(b) by Fouquet et al. (U.S. Patent No. 5,699,462, issued December 16, 1997) (Fouquet '462). Applicant respectfully traverses the rejection.

Fouquet '462 discloses a switching element defining "a transmitting state and a reflecting state for a pair of intersecting waveguides that have a gap at their intersection. In the preferred embodiment, the switching element exhibits total internal reflection at the gap sidewall from one waveguide to the other when not in the transmitting state. In the transmitting state, index-matching liquid fills the gap, enabling light to continue in the original waveguide direction." (Fouquet '462, Abstract)

The Examiner's attention is directed to the fact that Fouquet '462 fails to disclose changing or altering a characteristic of a fluid, where the change in the characteristic is used to controllably direct a light beam from a first waveguide to a second waveguide

as positively claimed by Applicants. Specifically, Applicants' independent claims positively recite:

3. (Currently amended) A microfluidic optical switch comprising:
a fluid contained in a reservoir having a characteristic;
a first optical waveguide having an end located proximate said fluid;
at least one second optical waveguide having an end located proximate said fluid; and
an actuator coupled to said fluid for changing the characteristic of the fluid, wherein said characteristic is a deformable interface formed on said fluid, wherein said deformable interface is a position of a meniscus that controllably directs a light beam from said first optical waveguide to the at least one second optical waveguide. (emphasis added)

11. (Previously presented) A method for operating a microfluidic optical switch comprising:
supplying light through a first waveguide to be incident upon a fluid;
altering a characteristic of the fluid; and
directing, in response to the characteristic alteration, the light into a second waveguide, wherein said characteristic is a position of a meniscus. (emphasis added)

Applicants' invention is directed to a microfluidic optical switch in which an optical signal is switched without conversion to electrical form. In one embodiment, the microfluidic optical switch comprises an input waveguide or fiber, one or more output waveguides or fibers, a fluid filled reservoir and an actuator for changing a characteristic of the fluid in the reservoir. The reservoir is located proximate the ends of the waveguides or fibers. The input waveguide or fiber supplies light to the fluid in the reservoir. The actuator changes a characteristic of the fluid to alter a path of the light. By altering the fluid characteristic, the light is selectively switched into one or more of the output optical waveguides. The fluid characteristics that are controlled to facilitate switching are a fluid/fluid or air/fluid interface (e.g., meniscus).

In contrast, Fouquet '462 "diverts light from the input segment 20 of the first waveguide to the output segment 22 of the second waveguide, unless an index-matching material is located within the gap 27 between the aligned segments 20 and 26 of the first waveguide." Fouquet teaches the placing or removal of an index-matching material in a gap in order to divert or reflect light. This is clearly not what is taught by

Applicants. Applicants teach altering a characteristic of a fluid, not the removal or addition of a material to a gap. Therefore, Fouquet does not teach what is claimed by Applicants in claims 3 and 11. As such, claims 3 and 11 are allowable over the cited reference.

B. Claims 6, 7, 12, 13, 15, and 17

Claims 6, 7, 12, 13, 15, and 17 stand rejected as being anticipated under 35 USC § 102(b) by Fouquet et al. (U.S. Patent No. 5,699,462, issued December 16, 1997) (Fouquet '462). Applicant respectfully traverses the rejection.

Fouquet '462 discloses a switching element defining "a transmitting state and a reflecting state for a pair of intersecting waveguides that have a gap at their intersection. In the preferred embodiment, the switching element exhibits total internal reflection at the gap sidewall from one waveguide to the other when not in the transmitting state. In the transmitting state, index-matching liquid fills the gap, enabling light to continue in the original waveguide direction." (Fouquet '462, Abstract)

The Examiner's attention is directed to the fact that Fouquet '462 fails to disclose changing or altering a characteristic of a fluid, where the change in the characteristic is used to controllably direct a light beam from a first waveguide to a second waveguide as positively claimed by Applicants. Specifically, Applicants' independent claims positively recite:

6. A microfluidic optical switch comprising:
a fluid contained in a reservoir having a characteristic;
a first optical waveguide having an end located proximate said fluid;
at least one second optical waveguide having an end located proximate said fluid; and
an actuator coupled to said fluid for changing the characteristic of the fluid, wherein said characteristic is a controllable refractive index gradient that controllably directs a light beam from said first optical waveguide to the at least one second optical waveguide. (emphasis added)

7. A microfluidic optical switch comprising:
a fluid contained in a reservoir having a characteristic;
a first optical waveguide having an end located proximate said fluid;

at least one second optical waveguide having an end located proximate said fluid; and

an actuator coupled to said fluid for changing the characteristic of the fluid, wherein said fluid further comprises a controllable refractive index gradient region that is controlled by an electric signal to direct a light beam from said first optical waveguide to the at least one second optical waveguide. (emphasis added)

12. A method for operating a microfluidic optical switch comprising:

supplying light through a first waveguide to be incident upon a fluid;

altering a characteristic of the fluid; and

directing, in response to the characteristic alteration, the light into a second waveguide, wherein said characteristic is a refractive index gradient. (emphasis added)

Applicants' invention is directed to a microfluidic optical switch in which an optical signal is switched without conversion to electrical form. In one embodiment, the microfluidic optical switch comprises an input waveguide or fiber, one or more output waveguides or fibers, a fluid filled reservoir and an actuator for changing a characteristic of the fluid in the reservoir. The reservoir is located proximate the ends of the waveguides or fibers. The input waveguide or fiber supplies light to the fluid in the reservoir. The actuator changes a characteristic of the fluid to alter a path of the light. By altering the fluid characteristic, the light is selectively switched into one or more of the output optical waveguides. The fluid characteristic that is controlled to facilitate switching is a refractive index gradient.

In contrast, Fouquet '462 "diverts light from the input segment 20 of the first waveguide to the output segment 22 of the second waveguide, unless an index-matching material is located within the gap 27 between the aligned segments 20 and 26 of the first waveguide." Fouquet teaches the placing or removal of an index-matching material in a gap in order to divert or reflect light. This is clearly not what is taught by Applicants. Applicants teach altering a characteristic of a fluid, e.g., the refractive index of the fluid is altered, not the removal or addition of a material to a gap. Therefore, Fouquet does not teach each and every element of claims 6, 7, and 12.

Moreover, claims 13, 15, and 17 depend from independent claim 12 and recite additional features therefor. Since independent claims 6, 7, and 12 are not anticipated

by Fouquet '462, dependent claims 13, 15, and 17 are also not anticipated for the same reason noted above and fully satisfy the requirements of 35 U.S.C. § 102.

C. Claims 4 and 5

Claims 4 and 5 stand rejected as being anticipated under 35 USC § 102(e) by Fouquet et al. (U.S. Patent No. 6,487,333, issued November 26, 2002) (Fouquet '333). Applicant respectfully traverses the rejection.

Claim 4 is canceled by this response, thereby rendering its rejection moot. Thus, the discussion of this section will pertain only to claim 5.

Fouquet '333 discloses an optical switch comprising "a substrate, a planar waveguide circuit, an index-matching liquid, a working fluid and a displacing device. The planar waveguide circuit is supported by the substrate. The planar waveguide circuit and the substrate collectively define a trench that includes a first trench region and a second trench region adjacent the first trench region. The second trench region has a width greater than the first trench region. The planar waveguide circuit includes a first waveguide and a second waveguide. The waveguides intersect at the first trench region and are positioned such that light traversing the first waveguide enters the second waveguide when an index-matching material is present in the first trench region, and is otherwise reflected by said the first trench region. The index-matching liquid is located in at least part of the first trench region. The working fluid is located in the second trench region. The displacing device is coupled to the second trench region, and is for displacing part of the working fluid into the first trench region to interpose the index-matching liquid between the waveguides."

The Examiner's attention is directed to the fact that Fouquet '333 fails to disclose changing or altering a characteristic of a fluid, where the change in the characteristic is used to controllably direct a light beam from a first waveguide to a second waveguide as positively claimed by Applicants. Claim 5 depends directly from independent claim 3, which reads as follows:

3. (Currently amended) A microfluidic optical switch comprising:
a fluid contained in a reservoir having a characteristic;

a first optical waveguide having an end located proximate said fluid;
at least one second optical waveguide having an end located proximate said fluid; and
an actuator coupled to said fluid for changing the characteristic of the fluid, wherein said characteristic is a deformable interface formed on said fluid, wherein said deformable interface is a position of a meniscus that controllably directs a light beam from said first optical waveguide to the at least one second optical waveguide. (emphasis added)

Applicants' invention is directed to a microfluidic optical switch in which an optical signal is switched without conversion to electrical form. In one embodiment, the microfluidic optical switch comprises an input waveguide or fiber, one or more output waveguides or fibers, a fluid filled reservoir and an actuator for changing a characteristic of the fluid in the reservoir. The reservoir is located proximate the ends of the waveguides or fibers. The input waveguide or fiber supplies light to the fluid in the reservoir. The actuator changes a characteristic of the fluid to alter a path of the light. By altering the fluid characteristic, the light is selectively switched into one or more of the output optical waveguides. The fluid characteristics that are controlled to facilitate switching are a fluid/fluid or air/fluid interface (e.g., meniscus).

In contrast, Fouquet '333 discloses that "[i]ndex-matching liquid 404 is located in part of trench region 413. Working fluid 406 is located in trench region 411. The working fluid and the index-matching liquid are mutually immiscible." (Fouquet '333, col. 8, lines 30-33) "Displacing device 410 is located in trench region 411. The displacing device operates to displace part of working fluid 406 into trench region 413. The amount of the working fluid displaced is sufficient to interpose index-matching liquid 404 between waveguides 421 and 423. This is clearly not what is taught by Applicants. Applicants teach altering a characteristic of a fluid, not the use of a working material to displace an index-matching liquid. Therefore, Fouquet '333 does not teach each and every element of independent claim 3. Claim 5 is patentable at least by virtue of depending from claim 3.

III. Rejections Under 35 U.S.C. §103

A. Claims 2 and 14 (Fouquet '462)

Claims 2 and 14 stand rejected as being obvious under 35 USC § 103(a) in view of Fouquet et al. (U.S. Patent No. 5,699,462, issued December 16, 1997) (Fouquet '462). Applicant respectfully traverses the rejection.

Although the Examiner refers to claims 2 and 14, the body of the rejection refers to claim 8 and 14. Applicants assume that the Examiner meant to reject claims 8 and 14.

The Examiner concedes that Fouquet '462 does not specifically disclose that the actuation is provided by an incident light but further states that it would have been obvious to do so.

The Examiner's attention is directed to the fact that Fouquet '462 fails to disclose changing or altering a characteristic of a fluid, where the change in the characteristic is used to controllably direct a light beam from a first waveguide to a second waveguide as positively claimed by Applicants. Specifically, Applicants' Independent claims positively recite:

8. A microfluidic optical switch comprising:
a fluid contained in a reservoir having a characteristic;
a first optical waveguide having an end located proximate said fluid;
at least one second optical waveguide having an end located proximate said fluid; and
an actuator coupled to said fluid for changing the characteristic of the fluid, wherein said fluid further comprises a controllable refractive index gradient region that is controlled by an incident light to direct a light beam from said first optical waveguide to the at least one second optical waveguide. (emphasis added)

12. A method for operating a microfluidic optical switch comprising:
supplying light through a first waveguide to be incident upon a fluid;
altering a characteristic of the fluid; and
directing, in response to the characteristic alteration, the light into a second waveguide, wherein said characteristic is a refractive index gradient. (emphasis added)

Applicants' invention is directed to a microfluidic optical switch in which an optical signal is switched without conversion to electrical form. In one embodiment, the

microfluidic optical switch comprises an input waveguide or fiber, one or more output waveguides or fibers, a fluid filled reservoir and an actuator for changing a characteristic of the fluid in the reservoir. The reservoir is located proximate the ends of the waveguides or fibers. The input waveguide or fiber supplies light to the fluid in the reservoir. The actuator changes a characteristic of the fluid to alter a path of the light. By altering the fluid characteristic, the light is selectively switched into one or more of the output optical waveguides. The fluid characteristic that is controlled to facilitate switching is a refractive index gradient.

In contrast, Fouquet '462 "diverts light from the input segment 20 of the first waveguide to the output segment 22 of the second waveguide, unless an index-matching material is located within the gap 27 between the aligned segments 20 and 26 of the first waveguide." Fouquet teaches the placing or removal of an index-matching material in a gap in order to divert or reflect light. This is clearly not what is taught by Applicants. Applicants teach altering a characteristic of a fluid, not the removal or addition of a material to a gap. Therefore, Fouquet '462 does not teach or suggest each and every element of claims 8 and 12.

Moreover, claim 14 depends from independent claim 12 and recites additional features therefor. Since independent claims 8 and 12 are made obvious by Fouquet '462, dependent claim 14 is also not obvious for the same reason noted above and fully satisfies the requirements of 35 U.S.C. § 103.

B. Claims 2 and 14 (Fouquet '333)

Claims 2 and 14 stand rejected as being obvious under 35 USC § 103(a) in view of Fouquet et al. (U.S. Patent No. 6,487,333, issued November 26, 2002) (Fouquet '333). Applicant respectfully traverses the rejection.

Although the Examiner refers to claims 2 and 14, the body of the rejection refers to claim 8 and 14. Applicants assume that the Examiner meant to reject claims 8 and 14.

The Examiner's attention is directed to the fact that Fouquet '333 fails to disclose changing or altering a characteristic of a fluid, where the change in the characteristic is

used to controllably direct a light beam from a first waveguide to a second waveguide as positively claimed by Applicants. Specifically, Applicants' independent claims positively recite:

8. A microfluidic optical switch comprising:
a fluid contained in a reservoir having a characteristic;
a first optical waveguide having an end located proximate said fluid;
at least one second optical waveguide having an end located proximate said fluid; and
an actuator coupled to said fluid for changing the characteristic of the fluid, wherein said fluid further comprises a controllable refractive index gradient region that is controlled by an incident light to direct a light beam from said first optical waveguide to the at least one second optical waveguide. (emphasis added)

12. A method for operating a microfluidic optical switch comprising:
supplying light through a first waveguide to be incident upon a fluid;
altering a characteristic of the fluid; and
directing, in response to the characteristic alteration, the light into a second waveguide, wherein said characteristic is a refractive index gradient. (emphasis added)

Applicants' invention is directed to a microfluidic optical switch in which an optical signal is switched without conversion to electrical form. In one embodiment, the microfluidic optical switch comprises an input waveguide or fiber, one or more output waveguides or fibers, a fluid filled reservoir and an actuator for changing a characteristic of the fluid in the reservoir. The reservoir is located proximate the ends of the waveguides or fibers. The input waveguide or fiber supplies light to the fluid in the reservoir. The actuator changes a characteristic of the fluid to alter a path of the light. By altering the fluid characteristic, the light is selectively switched into one or more of the output optical waveguides. The fluid characteristic that is controlled to facilitate switching is a refractive index gradient.

In contrast, Fouquet '333 discloses that "[i]ndex-matching liquid 404 is located in part of trench region 413. Working fluid 406 is located in trench region 411. The working fluid and the index-matching liquid are mutually immiscible." (Fouquet '333, col. 8, lines 30-33) "Displacing device 410 is located in trench region 411. The displacing device operates to displace part of working fluid 406 into trench region 413.

The amount of the working fluid displaced is sufficient to interpose index-matching liquid 404 between waveguides 421 and 423. This is clearly not what is taught by Applicants. Applicants teach altering a characteristic of a fluid, not the use of a working material to displace an index-matching liquid. Therefore, Fouquet '333 does not teach or suggest each and every element of claims 8 and 12.

Moreover, claim 14 depends from independent claim 12 and recites additional features therefor. Since independent claims 8 and 12 are made obvious by Fouquet '333, dependent claim 14 is also not obvious for the same reason noted above and fully satisfies the requirements of 35 U.S.C. § 103.

IV. New Claims

Claims 18 and 19 are added by this response. Claims 18 and 19 correspond to canceled claims 2 and 4 respectively. Applicants submit that new no matter is added by the addition new claims 18 and 19.

CONCLUSION

Thus, the Applicants submit that all of these claims now fully satisfy the requirements of 35 U.S.C. §102 and 35 U.S.C. §103. Consequently, the Applicants

believe that all these claims are presently in condition for allowance. Accordingly, both reconsideration of this application and its swift passage to issue are earnestly solicited.

If, however, the Examiner believes that there are any unresolved issues requiring the issuance of a final action in any of the claims now pending in the application, it is requested that the Examiner telephone Mr. Thomas Bethea, Jr., Esq. at (732) 530-9404 so that appropriate arrangements can be made for resolving such issues as expeditiously as possible.

Respectfully submitted,

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Date

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